18. State and prove Poynting's theorem.

19. Derive expressions for the electric and magnetic intensity for radiation from a centre fed half wave linear antenna. And hence show that its radiation resistance is 73.2 ohm.

20. Show that only waves smaller than twice the transverse dimension of the wave guide can propagate in a rectangular wave guide in TE mode.

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NOVEMBER/DECEMBER 2023

DPH22/GPH22 — ELECTROMAGNETIC THEORY

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Define electrostatic potential. Mention its importance.

2. Write the expression for energy density stored in a dielectric.

3. Define magnetic vector potential.

4. The divergence of magnetic field is zero-comment.

5. Write Maxwell's equations in free space.

6. Write Maxwell's equation.

7. What is an oscillating dipole? Show that time rate of change of dipole moment of an oscillating dipole is equal to a current element.

8. What is meant by antenna array?

9. What is a waveguide?

10. Compare TE, TM and TEM waves.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Obtain an expression for the electric field intensity due to a uniformly charged sphere.

Or

(b) Explain molecular polarizability and electric susceptibility.

12. (a) Deduce Ampere's circuital law in differential form and integral form.

Or

(b) Derive an expressions for magnetic induction due to a circular coil carrying current.

13. (a) What is gauge transformation? Discuss Lorentz gauge.

Or

(b) Obtain the continuity equation for current density.

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14. (a) Derive the expression for oscillating dipole in scalar potential.

Or

(b) Derive an expression for the resultant electric intensity due to an array.

15. (a) A plane electromagnetic wave travelling in a positive direction in a unbounded lossless dielectric medium with relative permeability and relative permeability has a peak electric field intensity $6\mathrm{Vm}^{-1}$. Find the speed of the EM wave, the impedance of the medium and the Poynting vector.

Or

(b) Discuss the reflection and refraction of electromagnetic waves at a plane interface.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Derive an expression for potential and field at a point inside and outside the dielectric sphere placed in an uniform electric field.

17. Explain Biot-Savart law and hence derive an expression for the magnetic induction at a distance from an infinitely long straight conductor carrying current